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1998

Ponniah, W. D. (1998). Land degradation. In AMIC Workshop on Management of Environmental Information Resources for Journalists : Singapore, Nov 9-14, 1998. Singapore: Asian Media Information and Communication Centre.

<https://hdl.handle.net/10356/80098>



AMIC / ADB TRAINING

for

**JOURNALISTS on MANAGEMENT of ENVIRONMENTAL
INFORMATION RESOURCES**

RIVER VIEW HOTEL, SINGAPORE,

9 – 14 NOV. 1998

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by

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Introduction

Land is the most valuable natural resource and fundamental to the life of mankind. It is a renewable resource so long as it is used according to its potential. Continued unplanned and unscientific exploitation leads to land degradation and to a non-renewable state. Land is the primary basis for production of food, fibre, fruit, fertiliser, fuel and many other essential goods needed to meet human and animal needs. This important resource therefore needs to be conserved, utilised and managed most prudently. However, it is facing serious threats of deterioration due to unrelenting human pressure and utilisation incompatible with its capacity.

Land degradation happens because people in the affected areas are driven by poverty to get as much out of the land as possible in the short term. It has an appalling impact on rural communities. It starts a vicious spiral of decline in health, the quality of life and life expectancy.

Extent of Land Degradation

Several definitions of land degradation have been suggested by different authorities to express the degree of impairment of land utilisation, or of land potential. In general, land degradation implies temporary or permanent regression from a higher to a lower status of productivity through deterioration of physical, chemical and biological aspects. The physical processes which contribute to land degradation are mainly water and wind erosion, compaction, crusting and waterlogging. The chemical processes include salinisation, alkalisation, acidification, pollution and nutrient depletion. The biological processes, on the other hand are related to the reduction of organic matter content in the soil, denudation of vegetation and impairment of activities of micro-organisms and fauna.

Most of the land suffers from moderate degradation, that is, its agricultural productivity is greatly reduced, but it can still be used for agriculture. The soil's ability to process nutrients into a form usable by plants has been partially destroyed and only with major improvements

can productivity be restored, Degradation of about 1 million hectares is classified as "extreme" as it is unreclaimable and beyond restoration.

Among countries of the region, the People's Republic of China is worst affected in terms of the area of land degradation followed by India and Vietnam. Despite massive soil degradation, agricultural yields have steadily increased in the Asia-Pacific region in the last forty years due to the use of improved high-yielding crop varieties, irrigation and increased agrochemical inputs.

The financial means of farmers contribute to their tendency to let soil degrade in two ways. Firstly, farmers planting decisions are usually influenced more by the current selling price of their crops than by long-term gains for themselves and society that could be realised from sustainable land use. Secondly, stopping or reversing widespread erosion which leads to moderate soil degradation often requires action on a scale beyond the means of a single farm unit.

Kinds of Land Degradation

GLASOD recognises two categories of human-induced soil degradation resulting from erosion processes with displacement of soil material, mainly through water erosion and wind erosion and from physical and chemical-biological deterioration.

Water Erosion

Water erosion is the most widespread erosion hazard in the region, caused mainly by excessive exposure of bare soil due to poorly managed logging operations, indiscriminate land clearance, widespread use of annual crops in farms, overgrazing, cutting of vegetation for fuelwood and inadequate management of run-off. Severe water erosion is extensive throughout the Himalayas and in South and South East Asia, large areas of the People's Republic of China, Australia and the South Pacific.

Wind Erosion

Wind erosion is widespread in arid and semi-arid lands such as Western China, Mongolia and the Central Asian Republics, though it occurs also along the shores of oceans, rivers and lakes where strong winds lift and carry the soil long distances. Fine grained soil particles are removed, leaving behind only the coarse - textured infertile soil. In extreme conditions, the soil and sand drifts and forms unstable dunes of varying height which encroach onto nearby agricultural land or settlements. Removal of vegetation cover and overgrazing contribute significantly to increasing the intensity of wind erosion.

Physical Deterioration of Soil

Land degradation also occurs due to poor aggregation, low or excessive permeability, defective aeration, low water retention, a decrease in rooting depth and other related characteristics. Heavy losses of nutrients take place in highly permeable soil and the availability of plant nutrients is limited in slowly permeable soils, both of which result in low fertiliser - use efficiency.

More than 50 per cent of the world's irrigated lands affected by waterlogging and salinisation are located in the region. In addition, 56 per cent of rain-fed croplands are also degraded.

Chemical Deterioration of Soil

It has been estimated that about 75 million hectares of soil has deteriorated chemically in the region during the last 45 years. Among these, the most dominant type is salinised soil which has spread over an area of 54 million hectares. About 15 million hectares suffers from nutrient loss, while acidified and polluted soils occupy 4 and 2 million hectares respectively.

In south East Asia, Indonesia has 2.2 million hectares of severely affected soils. In Malaysia, about 0.23 million hectares of saline marine clay soils are found in the Peninsula and in Sarawak. Some of these soils have been reclaimed for production of crops like coconut, oil palm, cocoa, coffee and paddy.

In Myanmar, approximately 1.4 per cent of the land is affected by saline soils, occurring mainly in the coastal belt, deltaic and arid areas. Salinisation in the arid region takes place due to saline ground water evaporation, inadequate leaching and use of saline irrigation water. In the Philippines, an estimated area of 0.4 million hectares affected by salinity occurs along 18,000 km coastline.

In Thailand, saline soils occupy 0.576 million hectares in the coastal area and parts of the central plain, while potentially saline soils cover over 3.04 million hectares. The severely affected coastal saline soils are used for salt making which involves heavy firewood consumption, thereby leading to extensive deforestation and environmental deterioration.

In Vietnam, coastal saline soils occupy 2.0 million hectares and 1.0 million hectares, mostly along 2,500 km of the coastline, and are of great agricultural importance.

Unregulated dumping of untreated industrial, municipal and agricultural wastes and mining rubble also give rise to land degradation and environmental problems. Heavy metals like mercury, lead, cadmium, nickel and arsenic cause serious land pollution problems.

Soil pollution due to high use of agrochemicals like fertilisers, insecticides, fungicides and herbicides has also been reported in recent years. The extensive use of pesticides, particularly with the advent of high-yielding crop varieties, poses an environmental problem due to harmful accumulation of non-biodegradable residues. They result in the deterioration of soil quality, due to their effect on the microfauna, bacteria, etc.

Desertification

Desertification is land degradation in arid, semi-arid and dry sub-humid areas, resulting from various factors including climatic variations and human activities. The Asia and Pacific region is the world's worst struck region in terms of numbers of people affected by desertification. 86 million hectares of precious land resources in the region have been affected. The countries most affected in the region are the People's Republic of China,

Islamic Republic of Iran, Afghanistan, Mongolia, Pakistan and India. 35 per cent of the region's productive land is considered to be desertified.

In the Asia and Pacific region, the process of desertification has resulted in an incalculable loss in land productivity and agricultural output since ancient times. Excessively high rates of deforestation have increasingly exposed land areas to the stresses that lead to desertification. Faulty agricultural practices, such as excessive or imbalanced use of chemical fertilisers and inadequate draining provisions of irrigated cropland provide the conditions for desertification of agricultural land.

The arid zones of the region suffer particularly from overgrazing of pastureland, a major cause of human-induced desertification. In these zones, people depend to a great extent on animal husbandry for their livelihood. On the one hand, low and variable rainfall results in reduced productivity of grassland. On the other hand, growing livestock populations exert pressure well beyond the carrying capacity of the pastures of the arid lands. Many people in several countries of the region rely heavily on livestock for their livelihood.

Causes and Consequences of Land Degradation Causes

The causes of land-degradation can be broadly grouped into two categories, natural and man-made. Apart from the natural causes, the basic factors that ultimately trigger the processes contributing to land degradation are increasing pressures from fast growing populations, removal of vegetation cover, unsustainable cultivation and irrigation, faulty mining and fossil fuel extraction and transport and dumping of waste materials.

Deforestation and Land Conversion

In this category, GLASOD includes conversion of forestland to agriculture, large scale logging and urban use. Deforestation continues to be a problem of serious concern in the Asia-Pacific region. FAO studies indicate that annual deforestation rates increased from 2 million hectares between 1976 to 1981 to 3.9 million hectares between 1981 to 1990. Among the tropical regions of the world, Asia and the Pacific has the fastest rate of deforestation, the

fastest rate of commercial logging, the highest volume of fuelwood removal and the fastest rate of species extinction. Among sub-regions, South East Asia had the highest deforestation rate followed by South Asia. At the current rate of deforestation, an area of about 50 million hectares is estimated to be deforested in the next 10 years.

With a few notable exceptions, forest cover has declined dramatically in the countries of the region during the past four decades. The countries with highest deforestation rates by absolute area are Indonesia, Thailand, Myanmar, Malaysia, India and the Philippines. In percentage terms, the highest rates of deforestation has occurred in Bangladesh, Pakistan, Thailand, the Philippines, Malaysia and Vietnam. The situation is particularly critical in Bangladesh, Pakistan, the Philippines and Thailand.

Overgrazing

Overgrazing by livestock decreases vegetation and exposes the soil to water and wind erosion. In addition, livestock compacts the soil, reducing its capacity to retain moisture. This is another important cause of soil degradation in the region affecting 280 million hectares. In Australia, over-grazing causes 80 per cent of soil degradation mainly in semi-arid and arid regions. Not only is the rangeland damaged by the destructive current grazing practices. Forests also suffer from livestock raving as branches are cut for fodder. In India, the loss of forest to cattle stems from the lack of grazing land. The nations 12 million hectares of permanent pastures are grossly inadequate to meet the needs of its 196 million herd of cattle.

Agricultural activities

Unsustainable agricultural practices account for 25 per cent of the degraded soils in the Asia and Pacific region. Common agricultural practices, such as insufficient use of fertilisers and shortening of fallow periods in shifting cultivation can lead to a loss of nutrients. Too much fertiliser, on the other hand, can lead to soil acidification. Cultivating hillsides without adequate preventive measures leads to water erosion and leaving soils exposed during fallow periods often results in wind erosion. Use of heavy machinery compacts soil, resulting

in physical damage. Insufficient drainage of irrigation water may cause salinisation. Regionwide, irrigation is essential to grow crops to feed growing populations but the long-term sustainability remains in doubt.

By saturating soil surfaces that are subsequently baked by sun, irrigation tends to deposit salts and other minerals where they interfere with root growth. Irrigation can also raise water tables under crops, waterlogging the root zone and adding to salinisation.

Furthermore, a large number of reservoirs constructed to augment irrigation and to generate electric power, lead to land degradation and reduced soil productivity by submerging vast tracts of agricultural and forest lands and also by causing waterlogging and salinity, as in India and Pakistan.

An equally detrimental form of land-use is shifting cultivation, which has been an important cause of land degradation in many countries of the region. It is a traditional farming system and is practised over an area of 63.57 million hectares by about 22.7 million people in Bangladesh, Brunei Darussalam, Fiji, India, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, Papua New Guinea, the Philippines, Sri Lanka, Thailand and Vietnam.

In India, shifting cultivation is reported to be practised by 4.37 million people and in Bangladesh about 800,000 people depend on shifting cultivation where land degradation rates are high. Similar problems are encountered in the Philippines, Sri Lanka, Indonesia, Myanmar and Thailand. Vast tracts of land that are left after shifting cultivation are exposed to the natural forces of erosion, thereby resulting in land degradation in the hills and heavy siltation and floods in the plains.

Over-Exploitation

In dry areas, stripping land of vegetation for fuelwood also leads to wind and water erosion. Regionwide over-exploitation accounts for 5 per cent of the degraded soils. Destruction of vegetation cover is also caused by various national development activities. These include construction of roads, railway tracks, airfields and other communication systems, industrial expansion and urbanisation, reservoir and canal construction, mining, hydro-electric projects, etc. Industrialisation affects millions of hectares of the Asia-Pacific region through waste accumulation and leaks of chemicals and acidification by airborne pollutants, to name but a few causes. Furthermore, construction of roads in the hills can cause erosion and landslides as, for example, in the Himalayan belt.

Consequences

Land degradation has numerous economic, social and ecological consequences, onsite and offsite alike, such as decline in land productivity leading to reduced agricultural or forestry production, increased siltation of rivers, canals and drainage systems resulting in greater maintenance costs and shorter operational life of projects, decline in income of agricultural populations resulting in the further worsening of a poverty situation, increased rural-urban migration, increased frequency of natural disasters such as floods and landslides, the concomitant loss of life and property and loss of biodiversity.

In India, the average annual loss of plant nutrients from eroded soil is estimated to account for a loss of 30 to 50 million tons of agricultural production. In Java, it was estimated in 1988 that the onsite cost of soil erosion amounted to \$315 million annually.

The offsite impacts of land degradation are also significant for the countries of the region. The deposits of eroded soil in drainage channels, irrigation ditches or reservoirs are major problems. In general, high sediment loads in the rivers adversely affect aspects of river flow, raises bed level, causes bank erosion, hampers navigation and accentuates floods. These deposits also reduce the functions of dams and choke irrigation canals. Added to these factors is the negative consequences on local communities means for gaining adequate

nutrition and livelihood. Changes in the hydrology of catchment areas due to increasing soil erosion are manifested in increased flood frequency and severity as well as reduced availability of surface water during dry seasons.

Transport of wind eroded soil also causes serious problems. The movement of sand dunes through wind erosion severely affects farmlands, roads, railway tracks, canals, water courses buildings and other infrastructures and thus has immense negative impact on crop production. For example, in India, 77.2 million hectares have been affected by water erosion and 7.8 million hectares by wind erosion. A loss of 1mm top soil in Nepal has been estimated to cause a loss of 10 kg nitrogen, 7kg phosphorus and 15kg of potassium per hectare. This fertility loss is reflected in reduction of crop yields. For example, with every centimetre of top soil removed, a reduction in maize grain yield by 100kg per hectare was noted at Deradun in India.

Policies to Combat Land Degradation

Several efforts have been made at the international, regional and national levels to develop monitoring and data collection methodologies, to formulate appropriate policies programmes and projects and to establish an institutional framework to combat land degradation.

National Actions

At the national level, the institutional set-up for formulation and implementation the policies and programmes is gradually being strengthened in countries of the region. A ministry or department level central agency is normally responsible for managing land resources. However, several other sectoral departments, research institutions and field agencies whose activities are related to land, are also involved through individual and collaborative efforts in tackling the issue. The work programme of these institutions involve a set of both curative and preventive measures, monitoring and data collection methodologies, research and technology innovation.

The implementation of corrective measures to abate the problem of land degradation is receiving the highest priority among efforts directed towards sustainable management of land resources in the countries of the Asia-Pacific region. In some cases, these measures are being implemented as elements of larger projects or programmes. Such measures include watershed management, soil and water conservation, sand dune stabilisation, reclamation of waterlogged and saline land, forest and range management as well as green manures and cultivation of appropriate crops.

The approach of integrated watershed management has been quite significant for projects that address issues of land degradation. It attempts to bring about desirable changes in a more holistic and systematic way to various watershed systems which were responsible for land degradation. The watershed management projects covered wide ranging aspects of the health of land such as farming systems, agro-forestry, forest and range awareness, infrastructure development and community participation. These projects have yielded encouraging results in terms of improving the overall condition of land resources.

International and Regional Actions

The United Nations Conference on Desertification held in Nairobi in 1977, played a major role in creating awareness of the serious threats to land from unsustainable exploitation and anthropogenic pressures at both national and international levels. It also resulted in the initiation of several actions at these levels to arrest further spread of desertification. In terms of monitoring and assessment, the United Nations Environment Programme initiated a three year study of the Global Assessment of Status of Human-induced soil Degradation (GLASOD) in 1987. The GLASOD study is associated with a more detailed global soils project called the World's Soils and Terrain Digital Database (SOFTER).

A recent major international achievement is the development of the International Convention to Combat Desertification. It was initiated at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 which, while expressing serious concern on land degradation, recommended that an International Convention to Combat Desertification be developed through a process of negotiation. The convention, so developed, was adopted in Paris on 18 June 1994 and has already been endorsed by the General Assembly of the United Nations.

A Regional Network of Research and Training Centres on Desertification Control in Asia and the Pacific (DESCONAP) was established in 1988 by ESCAP to combat desertification in Asia-Pacific. The network includes 19 governments, international organisations and non-government agencies. Besides promoting research-based case studies on soil Salinity and waterlogging in the Indus Basin of Pakistan, sand dune stabilisation in the People's Republic of China and mangrove reforestation in Vietnam, the project promoted training activities and public awareness on desertification. More recently, it has assisted in the development of National Plans of Action on Combating Desertification for Mongolia and Pakistan. Similar plans are being developed for the People's Republic of China and the Islamic Republic of Iran.

Conclusion

With roughly 58 per cent of the world's population depending upon only about a quarter of the world's land area, the pressure on land resources in the region to provide basic needs for the region's fast expanding population is increasing with time. This has led to unsustainable land-use practices such as clearance of forest for crop production, expansion of agriculture into marginal lands, widespread use of annual crops in farming systems, overgrazing, logging and removal of wood for meeting energy needs. In addition, inefficient irrigation practices, such as overwatering without the provision of outlets for excess water and mining and industrial waste dumping have also contributed to land degradation.

According to GLASOD, of the world's 1.9 million hectares of land affected by soil degradation, the largest area of approximately 850 million hectares is in the Asia-Pacific region. Overall 86 million hectares of precious land which includes 70 million hectares of rain-fed area and 16 million hectares of irrigated croplands have been affected by desertification. More than 50 per cent of the world's irrigated land that is affected by waterlogging and salinisation is located in the Asia-Pacific region. Altogether, 35 per cent of productive land in Asia is now desertified compared to 18 per cent in Africa, 28 per cent in North America and 17 per cent in South America. The region has the largest population in the world affected by desertification.

Land degradation is a significant problem across virtually all agro-ecological zones in Asia, the nature and scale of which varies widely among and even within countries of the region. Both water and wind erosion are major processes contributing to land degradation. Wind erosion is mainly restricted to Mongolia, western China, Central Asian Republic and the drier parts of India and Pakistan, where water erosion is the most widespread hazard throughout the region, due to unsustainable land-use practices and inadequate management of runoff. The higher rates of erosion in some parts of the region are due to the existence of highly erodible soils, such as losses in the People's Republic of China, limestone derived soils in Malaysia, dispersible soils such as those associated with the Palembang formation in eastern Sumatra and geologically young soil in Nepal. Fortunately, over the past four years, considerable initiatives have been undertaken at the national regional and global level to arrest land degradation.

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